UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/648,317	08/27/2003	Ryo Kuroda	03560.003343	3665

5514 7590 06/12/2006

FITZPATRICK CELLA HARPER & SCINTO
30 ROCKEFELLER PLAZA
NEW YORK, NY 10112

EXAMINER	
RUGGLES, JOHN S	

ART UNIT	PAPER NUMBER
1756	

DATE MAILED: 06/12/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Supplemental

Office Action Summary

Application No.	Applicant(s)	
10/648,317	KURODA ET AL.	
Examiner	**Art Unit**	
John Ruggles	1756	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *03 May 2006*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1,3-6 and 15-18* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☒ Claim(s) *1,5 and 6* is/are allowed.

6)☒ Claim(s) *3,4 and 15-18* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *07 March 2006* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☒ Interview Summary (PTO-413) Paper No(s)/Mail Date. *20060601*.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

Supplemental - DETAILED ACTION

Response to Amendment

This Office action is ***supplemental*** to the FINAL Office action mailed on 5/3/06 to give additional consideration for another amendment filed by Applicants on 5/3/06, crossing in the mail with the 5/3/06 FINAL Office action. Therefore, Applicants' response to this ***supplemental*** Office action must also be responsive to all issues addressed in the 5/3/06 FINAL Office action.

In the most recent submission filed on 5/3/06, claims 1 and 4-6 remain as previously presented (after the examiner amendment for allowance authorized by a telephone interview with Jack Cubert on 1/4/06), claim 3 has been re-presented as previously amended on 11/14/05 (but without the previously agreed-upon examiner amendment in line 2 of "opening" (singular) to --openings-- (plural)), claims 2 and 7-14 remain as previously canceled, claims 14-16 remain as previously presented, and claims 17-18 are now currently added as new. Therefore, only claims 1, 3-6, and 15-18 remain under consideration.

Information Disclosure Statement

See the previous FINAL Office action mailed on 5/3/06.

Drawings

See the previous FINAL Office action mailed on 5/3/06.

Claim Rejections - 35 USC § 112

See the previous FINAL Office action mailed on 5/3/06.

Claim Rejections - 35 USC § 103

The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

The following rejection supersedes that under this section set forth in the previous FINAL Office action mailed on 5/3/06.

Claims 15-18 are rejected under 35 U.S.C. 103(a) as being unpatentable over either Kuroda et al. (US Patent 6,171,730) or Kuroda et al. (US Patent 6,187,482) in view of Ebbesen et al. (US Patent 6,236,033) and/or Alkaisi, M. M. et al., ("Sub-diffraction-limited patterning using evanescent near-field optical lithography", (1999) Applied Physics Letters).

Kuroda et al. '730 teach a near field evanescent light exposure process and a near field exposure apparatus that includes a near field mask having an opaque shading layer with aperture widths of about 100 nm or less (title, abstract), but preferably in the range of 1-100 nm, as shown by Figures 2A and 2B (col. 5 line 41 to col. 6 line 40). Figure 2A shows rectangular block form L-shaped slit openings in the opaque shading layer on the near field mask, but any desired pattern of slit openings such as S-shaped slit openings or the like are also contemplated (col. 6 lines 40-42). Figures 8A and 8B show a near field mask having rectangular block form L-shaped slit openings of different widths in the opaque shading layer, but the shape, width, length, and size of the slit openings are not limited so that any desired shape can be selected, such as specifically contemplated S-shaped slit openings (col. 13 lines 12-15). In Figure 8A, the width of the light shading layer portion between adjacent parallel first slit openings appears to be equal to the width of perpendicular second slit openings and this relationship is further contemplated to also be preserved for alternative S-shaped slit openings. The near field exposure apparatus

shown by Figure 1A includes a collimator lens 103 to conform exposure light from the light source into parallel light beams 102 for exposure through the near field mask 106 (col. 3 line 45 to col. 4 line 10).

Kuroda et al. '482 teach a near field mask for evanescent light exposure and an apparatus for making a pattern using the near field mask (title, abstract). The mask includes a transparent base or substrate 201 and a metallic thin film shading member 203 having minute apertures 204, each having a width < 100 nm, which is small in comparison with the wavelength of exposure light (abstract, Figure 2, col. 4 lines 49-54). The width of the apertures is specifically stated to be less than the wavelength of exposure light (col. 7 lines 61-62). Figure 3A shows hook-shaped (rectangular block form L-shaped) slit openings 303 less than 100 nm wide in the opaque shading layer on the near field mask, but there is no limit on length and the patterns can be selected freely in this direction, such as specifically contemplated alternative S-shaped slit openings (col. 7 line 13 to col. 8 line 15). Also in Figure 3A, the width of the light shading layer portion between adjacent parallel first slit openings appears to be equal to the width of perpendicular second slit openings and this relationship is further contemplated to also be preserved for alternative S-shaped slit openings. The exposure apparatus shown by Figure 1 includes a collimator lens 103 to conform exposure light from the light source 101 into parallel light beams 102 for exposure through the near field mask 106 of a resist 107 (col. 4 lines 1-45).

Neither Kuroda et al. '730 nor Kuroda et al. '482 specifically teach ***[1]*** a near field mask having a light shielding film with two or more first slit openings lengthening in a first direction that are interlinked by a second slit opening lengthening in a second direction, ***[2]*** inclusion of a light illuminating means for illuminating polarized light along the first direction parallel to the

first slit openings of the near-field mask in the near-field exposure apparatus, nor ***[3]*** the capability of forming a latent-dot-image on an exposure target (instant claims 15-18).

Ebbesen et al. teach enhanced optical transmission apparatus utilizing metal films having apertures (title) for various applications, including near-field optical devices and masks for sub-wavelength photolithography (abstract, col. 2 lines 27-28). Figure 17A shows a mask having a metal blocking layer with an H-shaped opening made up of first parallel slit openings connected by a perpendicular interlinking second slit opening for exposure of a resist (col. 15 lines 25-30). The exposure wavelength is much greater than the size of apertures or the width of slit openings (124a, col. 15 lines 18-20, even to the extent that the ratio of slit opening width to the exposure wavelength can be as small as about 0.1, col. 2 lines 61-67) and this exposure wavelength is described to come from a "regular UV light source" instead of a deep-UV source (col. 15 lines 40-42, which is understood to mean that the exposure wavelength is in the range of 300 nm to 400 nm). Therefore, the slit opening width can be as small as 0.1 times the exposure wavelength or about 30 nm to 40 nm. When the incident exposure light is "p-polarized" to have an electric field parallel to the x-axis while the metal film is rotated about the y-axis through an angle θ as shown by Figure 7, the coupling of light with surface plasmons on the metal surface with any periodic structure (such as a periodic surface topography or a periodic array of apertures or slit openings) follows momentum conservation (col. 9 lines 23-30). The beneficial increase in photon energy or light intensity for the metal surface having periodic structures is shown by Figure 8B in comparison to Figure 8A for the metal surface without periodic structures (col. 10 lines 1-7).

As discussed above, Ebbesen et al. teach a beneficial increase in light intensity for exposure of a resist when the incident exposure light is polarized to have an electric field parallel to the x-axis of a mask having periodic structures and an H-shaped opening made up of first parallel slit openings connected by a perpendicular interlinking second slit opening.

Alkaisi et al. teach clear and faithful reproduction through a near-field mask having rectangular apertures or slit openings that are 70 nm wide (which is < 1/5 times the wavelength of incident light). High transmission (intensity of transmitted light) through the mask slit openings is always achieved for at least one polarization of incident light through the near-field mask as shown by Figure 2(b) (page 3561, left col., fourth full paragraph). Polarization of incident light in the direction perpendicular to the mask slit apertures (for transverse magnetic (TM) polarization) results in high light transmission through the mask slit apertures to expose a resolved pattern in the top 40 nm of the resist layer (as shown in Figure 3(a) on page 3562, left col., last paragraph), whereas polarization of incident light in the direction parallel to the mask slit openings (for transverse electric (TE) polarization) does not result in a clearly resolved pattern to any depth in the resist layer (as shown in Figure 3(b) on page 3562, right col., lines 1-4). Thus, exposure of the resist will be dominated by the well-resolved, high-intensity TM profile (page 3562, right col., lines 4-7).

It would have been obvious to one of ordinary skill in the art at the time of the invention to have included a light polarizer to direct illumination light along a particular direction with regard to slit openings in the near field mask (as taught by Ebbesen et al.) in the near field exposure apparatus (as taught by either Kuroda et al. '730 or Kuroda et al. '482) in order to achieve a beneficial increase in light intensity for directional exposure of a resist through the

mask pattern (as taught by Ebbesen et al.). Also, it would have been obvious in the near field exposure apparatus taught by either Kuroda et al. '730 or Kuroda et al. '482 to have included a light polarizer to direct illumination light perpendicular to a second slit opening in a second direction that interlinks two first slit openings in a first direction in the near-field mask (particularly when it is desirable to selectively expose the resist by near field exposure through a mask as taught by Alkaisi et al. and the mask has openings in first and second directions that are approximately perpendicular to each other, e.g., for an H-shaped opening pattern on a near field mask, etc., as taught by Ebbesen et al.) in the near-field exposure apparatus using a near-field mask having parallel first slit openings interlinked by a perpendicular second slit opening. This is because Alkaisi et al. teach that exposure of the resist will be dominated by a well-resolved, high-intensity profile of the near-field mask slit openings running in a direction that is perpendicular to the direction of polarized incident light. Thus, in the near field mask exposure using a near field mask having parallel first slit openings running in a first direction interlinked by a perpendicular second slit opening running in a second direction, the resulting resist image would be expected to be dominated by stronger exposure through the second slit opening without exposure through the first slit openings, when the incident light is polarized in a direction parallel to the first slit openings and perpendicular to the second slit openings (as taught by Alkaisi et al. in combination with either Kuroda et al. '730 or Kuroda et al. '482 and Ebbesen et al., *[1]*, *[2]*). For at least the reasons discussed above, one of ordinary skill in the art would also have a reasonable expectation of success for forming a latent-dot-image on an exposure target under the second slit opening interlinking two parallel first slit openings of the H-shaped opening on the near field mask (taught by Ebbesen et al.) in the near field exposure apparatus (taught by either

Kuroda et al. '730 or Kuroda et al. '482) that projects incident light onto this near field mask in an incident direction that is perpendicular to the lengthwise direction of the second slit opening on the near field mask (as taught by Alkaisi et al., *[3]*).

Allowable Subject Matter

Claims 1 and 5-6 are allowed.

See the previous FINAL Office action mailed on 5/3/06 for the statement of reasons for allowance of these claims.

Response to Arguments

See the previous FINAL Office action mailed on 5/3/06.

Applicants' arguments with respect to claims 15-18 have been considered, but are moot in view of very similar ground(s) of rejection over the same art of record as set forth in a prior Office action, which have been rewritten as necessitated by Applicants' current amendment filed on 5/3/06 and could have been made final if these claims were presented earlier.

This Office action is ***supplemental*** to the FINAL Office action mailed on 5/3/06 to give additional consideration for another amendment filed by Applicants on 5/3/06, crossing in the mail with the 5/3/06 FINAL Office action. Therefore, Applicants' response to this ***supplemental*** Office action must also be responsive to all issues addressed in the 5/3/06 FINAL Office action.

Conclusion

All claims are drawn to the same or similar invention as claimed in the application prior to the entry of the submission under 37 CFR 1.114 and could have been finally rejected on the grounds and art of record in the next Office action if they had been entered in the application prior to entry under 37 CFR 1.114. Accordingly, **THIS ACTION IS MADE FINAL** even

though it is ***supplemental*** to a first action after the filing of a request for continued examination (RCE) and the submission under 37 CFR 1.114. See MPEP § 706.07(b). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to John Ruggles whose telephone number is 571-272-1390. The examiner can normally be reached on Monday-Thursday and alternate Fridays.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Mark Huff can be reached on 571-272-1385. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

John Ruggles
Examiner
Art Unit 1756

S. ROSASCO
PRIMARY EXAMINER
GROUP 1500